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14. ABSTRACT - Effective handoffs of care are frequently cited as critical for maintaining safety and avoiding communication problems. This program of work examines multiple handoff types, in multiple phases of care, and uses multiple dimensions of intervention, based on a previous model of improvement, to fundamentally improve transitions of care along the trauma pathway. We have considered all potential handoffs and care transitions during trauma care, their characteristics and how they might affect care, and mapped out the key transition processes along the care pathway. Next, using data collected during our first phase of work, we conducted an analysis of the variety of paths that patients take, the frequencies of each path, the number of transitions they experience, and the disruptions that occur during transition. On average 87% of patients experienced a transition flow disruption during their care, with 49% associated with co-ordination problems. We have also analyzed previous incident data to examine core weaknesses in handoffs across the breadth of care. We will examine three types of handoff: key team handoffs along the trauma pathway; micro-transitions during this period associated with the fluidity of the trauma team; and shift-to-shift handoffs in the ICU. In the next four months we will finalize and deploy task, process and teamwork observation metrics for the variety of handoffs and transitions that occur during trauma care, continue to analyze existing data, and conduct evaluative part-task simulations of our early interventions. Two interventions – Smartphone technology and a Checklist – are already in development as an extension of previous work, with simulation evaluation planned.

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Introduction

Effective handoffs of care are frequently cited as critical for maintaining safety and avoiding communication problems. Transitions in trauma care, like other forms of handoffs, are vulnerable to systems problems and human errors. This project is taking a mixed-methods approach to understanding, modeling, and improving handoffs in trauma care.

Taking a previously successful model of handoff that reported improvements using expertise from aviation and motor racing, this project examines the integration of team, process, and information transfer for efficient patient management and safety. Superimposing interventions upon this human-centered model of care, we are able to examine individually and in combination, interventions associated with technological, training, environmental and task redesign. We will also focus on the post-operative recovery period and identify those flow disruptions and communication failures in care which inhibit early recognition and treatment of complications and other subtle barriers to recovery.

Most handoff studies have been conducted in isolation, examining only one type of handoff during one phase of care, with only rare interventions. This program of work examines multiple handoff types, in multiple phases of care, and uses multiple dimensions of intervention, based on a previously strong model of improvement, to fundamentally improve transitions of care along the trauma pathway.

Body

We developed three protocols to complete the tasks within our statement of work. The first protocol, titled "Military Operating Room of the Future Phase II – Handoffs: Observations" received approval from HRPO on October 17, 2012. The other two protocols, titled "Military Operating Room of the Future Phase II – Handoffs: Database Review" and "Military Operating Room of the Future Phase II – Handoffs: Focus Groups" are currently being entered into the Madigan Army Medical Center IRB.

To measure before and after effects, we are utilizing modified objective observational tools. We have been investigating the critical handoffs between care providers as traumatized and critically ill patients progress from admission to diagnostic areas, operating rooms and intensive care units. In developmental work, we have considered all potential handoffs and care transitions, their characteristics and how they might affect care, and mapped out the key transition processes along the care pathway. Next, using data collected during our first phase of work, we conducted an analysis of the variety of paths that patients take, the frequencies of each path, the number of transitions they experience, and the disruptions that occur during transition. We have also analyzed previous incident data to examine core weaknesses in handoffs across the breadth of care. Two interventions are already in development as an extension of previous work, with simulation evaluation planned.

Overall, we have made excellent progress and will continue to develop our metrics and understanding as we begin a three month intensive data collection, moving to a three month intervention period, followed by a final three month post-intervention data collection period.

Aim 1, Task A: process mapping using practice management guidelines

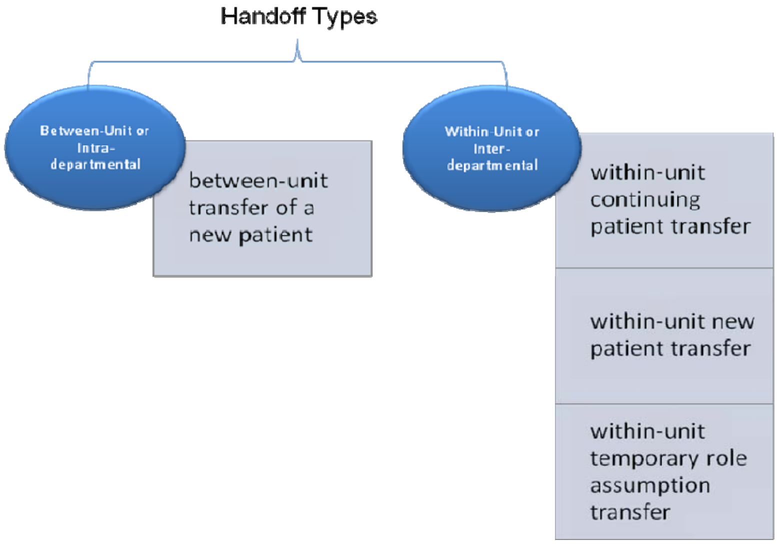


Figure 1: Handoff Types

The first key development in this project – and the first question to focus on – requires an expansion of the view of what constitutes a handoff. Given that there are many changes in personnel and many movements and changes of information during a trauma care episode, this is not a trivial consideration. Traditional definitions of handoff usually refer to a change in care team (e.g. shift-to-shift), or a change in patient location (eg. OR to ICU), and trauma care certainly requires these very clear handoffs. In particular, we are studying ICU shift-to-shift handoffs; and EMT to ED/trauma team handoffs. Early pilot observations have helped us identify key aspects of the process and more detailed questions that will need to be examined as we move forward (Table 1). However, trauma has further handoff elements which go beyond these simple definitions, and highlight key features and potential risks of trauma care. In particular, patients move between departments without necessarily changing the care team (e.g. patient transition from ED to CT), which still requires many similar aspects of the traditional view of handoff, while trauma teams are particularly fluid and members may change frequently, requiring micro-handoffs to ensure continuity of care. Both situations create the risk that the full set of information regarding the patient may not always be transferred as the patient moves through the care system. In addition, there can be problems with teamwork, where incoming staff assume a different role to outgoing staff. The risks associated with this fluidity and role uncertainty is exacerbated by the continually changing information about the patient that develops through the course of their treatment. These features make transitions in trauma care especially important to study.

The best approach is to model handoffs as having a range of systemic components, and to consider handoffs not as a one-off information transfer but as a dynamic part of ongoing care. This will be a substantial development beyond existing handoff considerations, that have traditionally focused on narrower definitions and solutions limited to training and standardization. The initial process map (figure 2) illustrates both key information exchanges, and discrete handoffs. Our studies will move forward by examining the flow of information along the trauma pathway, examining the traditional handoff processes and the impact of teamwork. Direct observations will also track these micro-handoffs from a task, team and information perspective. We will also examine continuity of care handoffs in the intensive care unit, introducing a ‘flagging’ system to identify patients at risk.

Component	Initial Observation
TASK	30 patients / 1 min per patient. Update information on patient. Discuss diagnosis. Check & iterate decisions. Update diagnosis if necessary. Check if/why something not done. What co-morbidities are holding the patients up? What are the clinical milestones? What are the decision points? What clinical tasks need to be organized? Provide training/support/additional expertise, critical thinking, standards of care Plan for contingency. Manage dynamic changes. Funding / insurance considerations.
ENVIRONMENT	This handoff was conducted at the Nurses station. Interruptions and distractions. Need privacy to discuss sensitive issues.
TECHNOLOGY / TOOLS	Spread of documentation Charge nurse resource sheet. SBAR sheet. Charge nurse sheet. 'need to get away from filling in boxes' and to using their brain. Integration with CSLink. Dynamic access.
BEHAVIORAL FACTORS	People: Case manager, social worker, nurse. Motivations and responsibilities. Accuracy / detail of 7am handoff. Q and A interaction, not just SBAR Room number not name. How many times are patients confused? Eg moved on to new one, still talking about old. Etc. Who is in charge of process?
DECISION MAKING FACTORS	Accuracy and availability of information Situation awareness Expertise. Holistic. Gut feeling. Family / social issues. Some very difficult & sensitive. Who makes decisions for the patient (physician / spokesperson / family)?
ORGANIZATIONAL FACTORS	Timing of handoff(s) What role the physician(s)? Relationship with 7am nursing handover. Who is in charge of care? Is there a 'map' of DM, processing, discharge etc? What happens at end of handover. What does case manager do?

Table 1: Observation Notes on shift handover in the ICU

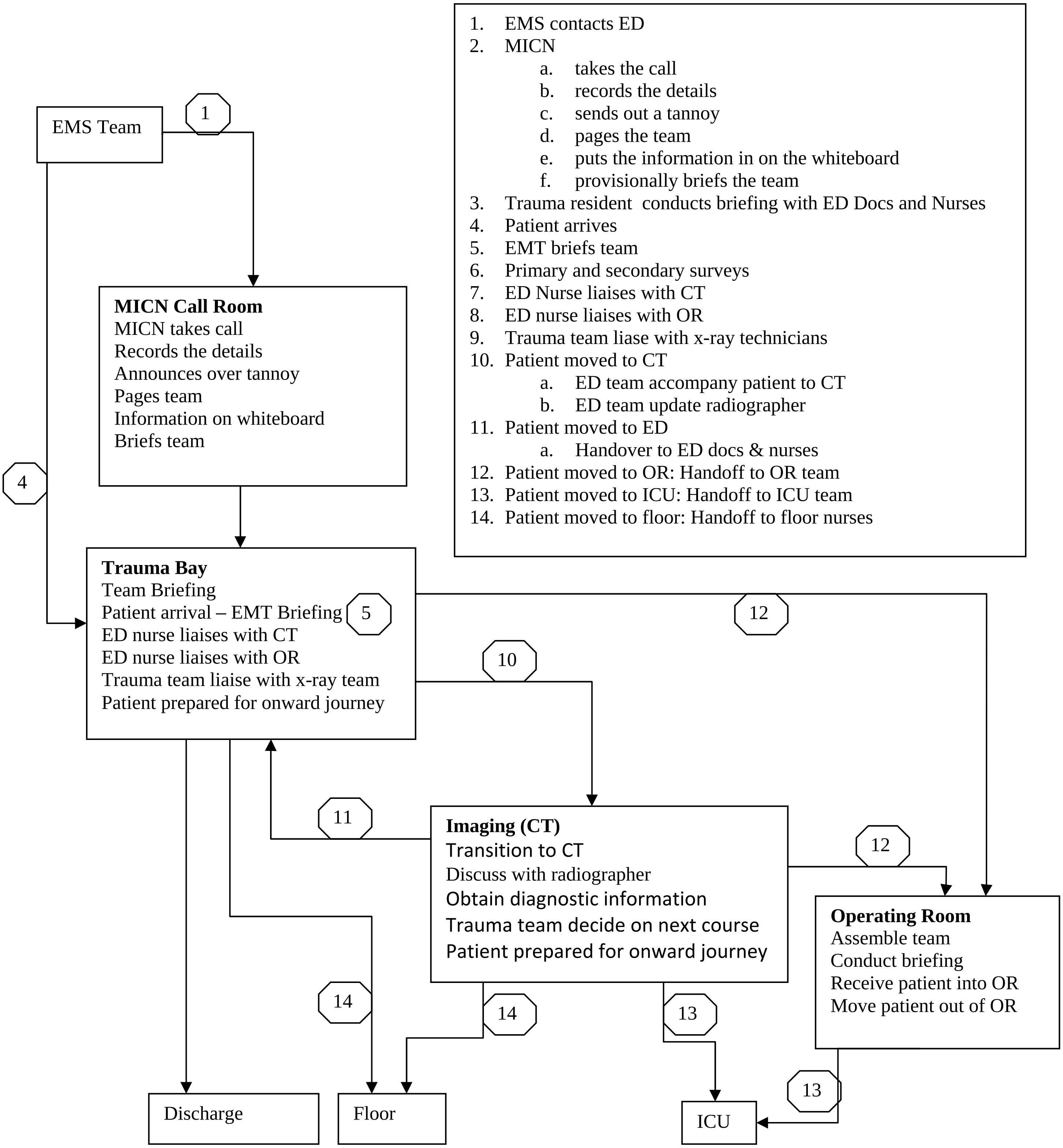


Figure 2: Handoffs and Information Flow along the Trauma Care Pathway

Aim 1, Task B: data collection on process deviations. Quantify adherence

Our phase I work has produced a huge wealth of directly observed details about the trauma care process which can tell us precisely what happens to each patient during their care episode. We have been interrogating this handoff data to examine where patients most frequently transition from and to, and the flow disruptions associated with those transitions (figure 3). A total of 69 patients were studied (13 high level and 56 low level traumas), and a total of 146 care transitions were observed, with flow disruptions occurring in 41% of care transitions. Given that many patients experience more than one transition, on average 87% of patients experienced a transition flow disruption during their care. Of those transition flow disruptions, 30 (49%) were related to co-ordination problems. Mapping the transitions of care shows that approximately 83% of patients were assessed and transferred to imaging for further diagnostics, with 46% of patients arriving back in the ED following imaging assessment to await further consultation or discharge assessment. 7% of patients return to the ED and then are transferred to the ICU or OR. Those patients who experienced more transitions experienced more transition flow disruptions and a longer case duration. Thus, reducing the number of transitions and improving co-ordination in transitions along the trauma pathway may reduce risks and improve efficiency.

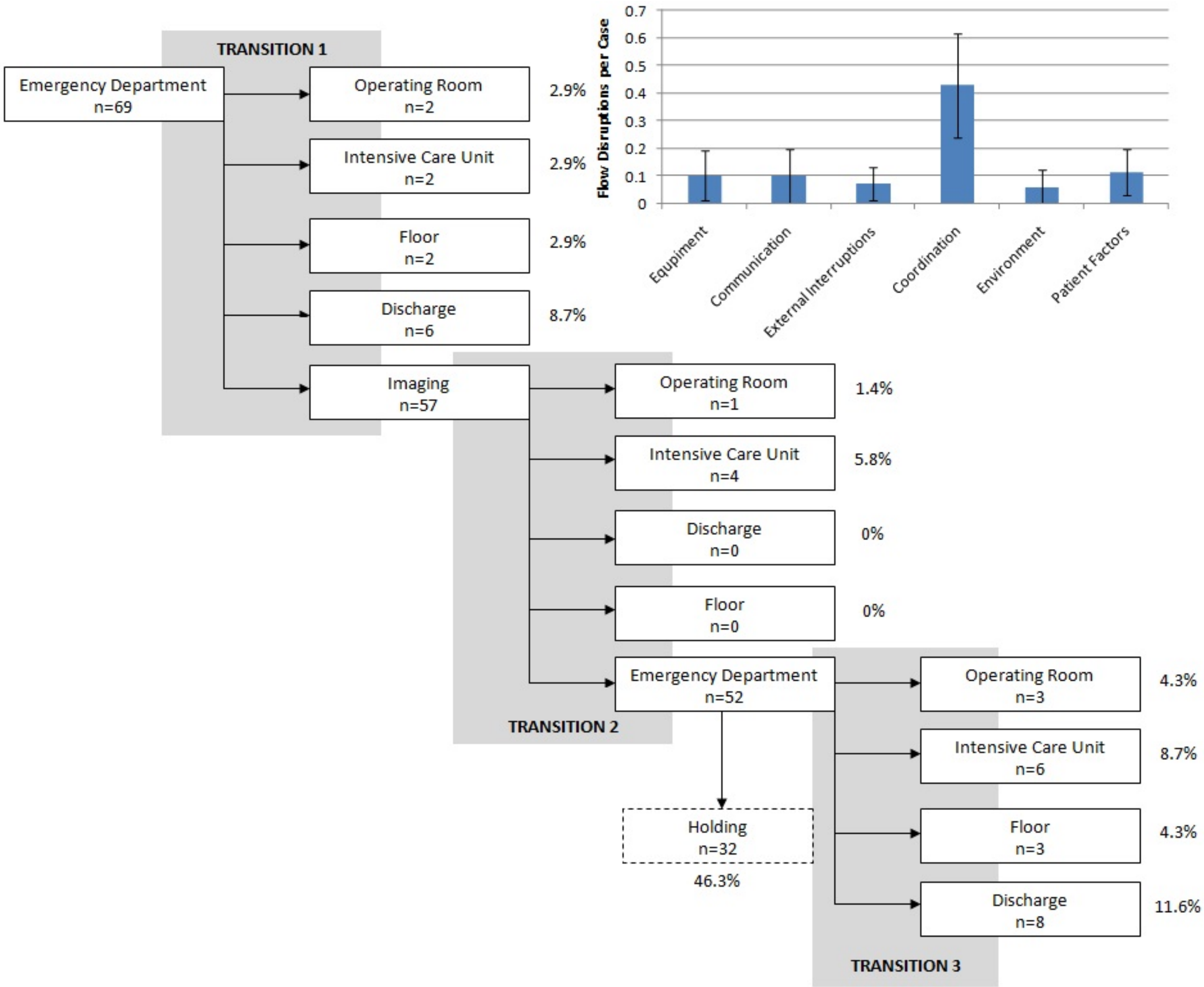


Figure 3: Observed flow disruptions during trauma care transitions.

Within two weeks, our second set of phase one flow disruption data will be complete, which will be analyzed in an identical way. This will help us to understand how the Phase I changes to teamwork and communication have affected the handoff process (if at all) and allow us to confirm or refute these early findings. Early analysis (figure 4) suggests a very similar pattern, which has not been substantially altered by our previous phase one studies and interventions. This reinforces the view that particular care and intervention plans are required for trauma care transitions.

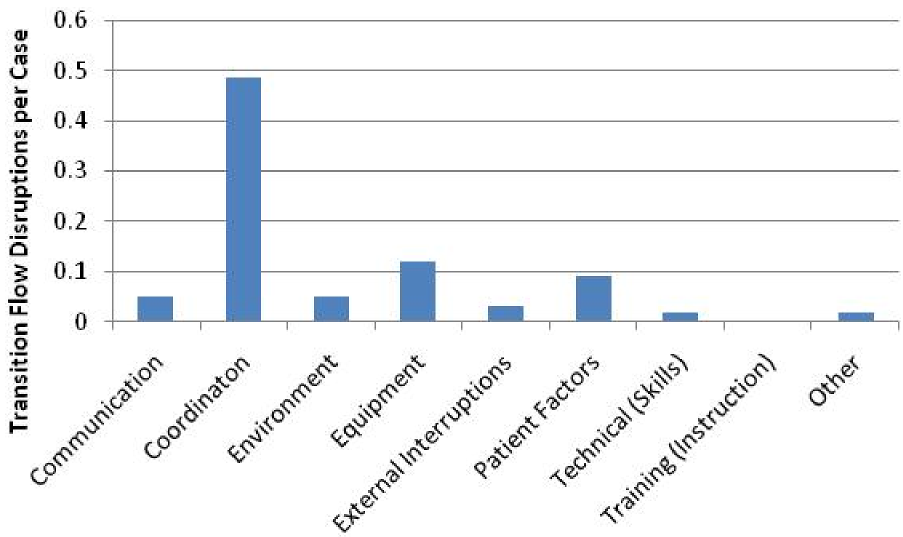


Figure 4: Transition flow disruptions per case (2nd phase data collection)

Aim 1, Task C: identify process deviations, attributing deviations to people, technology, and the environment

Sources of co-ordination problems are multi-factorial. We have been able to analyze our previous incident reports from this perspective, finding that team and task issues are most prevalent (figure 4). This would be supported by a range of previous studies in this area, and provide further weight to our approach of measuring process, teamwork and information flow in handoffs. However, given that this data originates from the more traditional handoffs, it is somewhat in conflict with the direct observations (figures 3 and 4). This supports a more advanced view of transitions that we have already observed as being key to success in trauma handoffs, demonstrating the unique necessity of the current studies. Our future plans will be to collect and analyze both the existing flow disruption data, and our new set of observational data in terms of these dimensions, and thus begin to consider areas for improvement in each phase and with each type of transition. We will also consider the interrelation between transitions, errors and information flow. The qualitative data – in the form of observer notes – will be extremely valuable for examining this in detail.

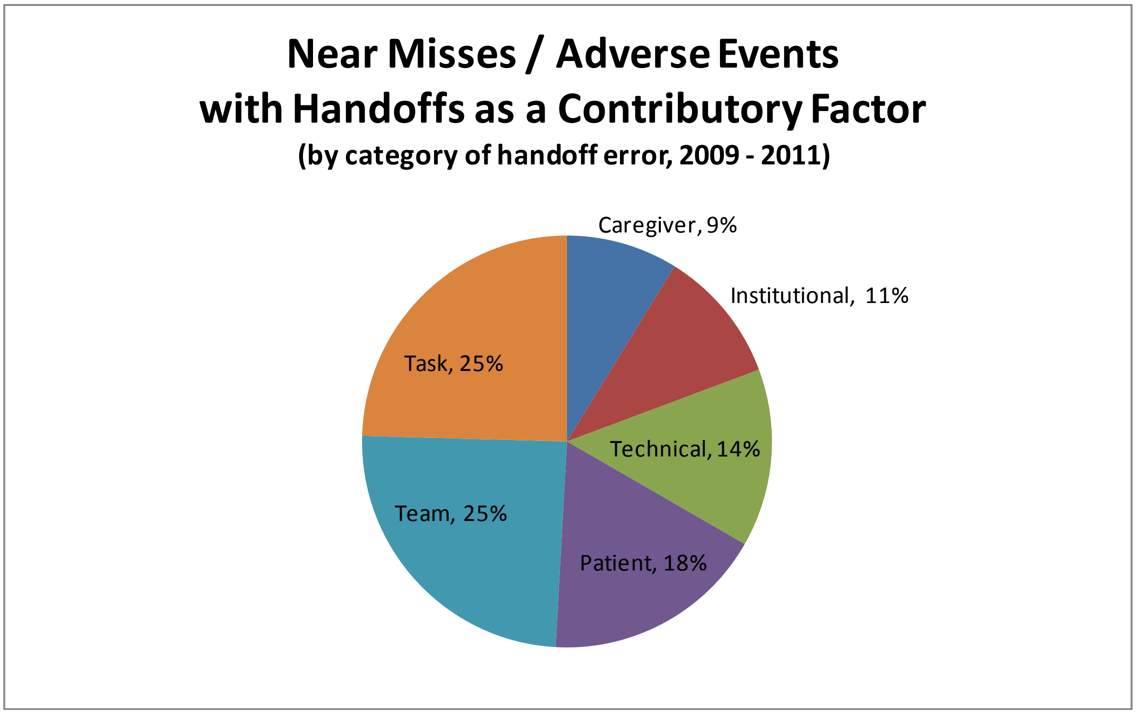


Figure 4: Results of incident database analysis

Aim 1, Task D: conduct prospective data collection

Having defined, mapped and examined trauma care handoffs, analyzed observational and incident data, and conducted pilot studies for data collection, we are currently finalizing the research design and strategy. Overall, the plan will be to conduct three months of initial data collection, followed by a three month period of intervention, and a second three month data collection period.

One researcher will examine handoffs associated with transitions to and from ED and other key team handoffs along the trauma pathway. A second researcher will examine information flow and micro-transitions during this period, looking at how information is sustained and communicated within the transient and fluidity of the trauma team. Finally, a third researcher will examine shift-to-shift handoffs and the introduction of a patient ‘flagging’ mechanism into ICU handoffs. In particular, this will identify patients who are most at risk. Currently, we are working to turn these three areas into working hypotheses that will be tested by looking at the dimensions of information, teamwork and process. An example of a simple measurement approach that we have been considering is found in figure 5, but we expect to go beyond this with our final data collection set.

All three types of handoffs will be modeled in a similar way – based on process, teamwork and information transfer – to allow for cross-comparison and concatenation studies that examine degradation over successive handoffs. However, each will have a unique scoring system, based on the key properties of each style of handoff, which will allow the risks of each are captured. In this way, we will be able to ensure that the complexities of each transition type are addressed, to understand the limitations and strengths of each, while providing enough analytical weight to allow the identification and evaluation of directed interventions.

Overall, the quality of this handoff ☐ Poor ☐ Fair ☐ Good ☐ Excellent		
Handoff followed a logical structure (Technical factor)	☐ Yes	☐ No
The person handing off the patient continuously used the available documentation (anesthesia record, patient chart, etc) to structure the handoff (task factors)	☐ Yes	☐ No
Enough time was allowed for the handoff (task factor)	☐ Yes	☐ No
Was there any interruptions during handoff (institutional/environmental factor)	☐ Yes	☐ No
All relevant information was selected and communicated (task factor)	☐ Yes	☐ No
Priorities for further treatment were addressed (task factor)	☐ Yes	☐ No
The person handing off the patient clearly communicated her/his assessment of the patient (Team factor)	☐ Yes	☐ No
Possible risks and complications were discussed (task factor)	☐ Yes	☐ No
It was easy to establish good contact at the beginning to the handoff (task factor)	☐ Yes	☐ No
There was tension within the team during handoff (team factor)	☐ Yes	☐ No
Questions and ambiguities were resolved (active enquiry on responsibility for the patient) (task factor)	☐ Yes	☐ No
The team jointly ensured that the handoff was complete (team factor)	☐ Yes	☐ No
There was too much information given (task factor)	☐ Yes	☐ No
The person handing off the patient was under time pressure (institutional factor)	☐ Yes	☐ No
The person taking on responsibility for the patient was under time pressure (institutional factor)	☐ Yes	☐ No

Figure 5: Handoff evaluation checklist

Aim 1, Task E: perform root cause analysis

The data already obtained from hospital incident reports provide early results from this task, with the core work commencing following the completion of the initial data collection.

Aim 1, Task F: feedback to current stakeholders

We have not commenced work on this task.

Aim 1, Task G: determine areas of high priority/high impact/high risk

We have not commenced work on this task.

Aim 2: Task A: design potential interventions

Following excellent progress and data analysis in phase one, two key interventions are currently in development, with more to be defined following the detailed data collection and root cause analysis.

Firstly, we have been in discussions and commenced early development of a Smartphone application that assists in the early management of trauma patient information. Though not directly focused on specific handoffs, we are confident that it will with handoffs in general, and may be extended specifically to address handoff issues in particular. Moreover, if it is suitable for deployment within our trauma setting, we will be able to evaluate the effect it has on handoffs. Beforehand, we will fully assess this software tool in simulation.

A second intervention currently being explored is a checklist for improving patients admission into CT. This is based on concerns information, team and process during transition to CT, and especially in ensuring appropriate preparedness for CT scanning. This need arose from a detailed study of flow disruptions during the CT process, where the hypothesis was generated that many of these disruptions could be addressed with an improved handoff process. For example, we have found that some patients can be delayed in the corridor waiting for the scanner to become available; and some are not appropriately prepared early for the removal of metal objects (especially earrings) from their person. We have also found flow disruptions in CT due to patients who move and we may be able to more adequately prepare for them for their time in scanning. This will be developed during the initial period of handoff observation, which means we will have already made positive progress toward change before the next set of data are analyzed.

Aim 2, Task B: develop protocols

We have not commenced work on this task.

Aim 2, Task C: tests of change in simulation

Simulation provides the opportunity to develop teamwork, task and technology prior to deployment. The general form of this type of simulation is first to examine sub-processes using part-task simulation; then to move to full fidelity simulation; and finally to operational validation. This ensures an iterative process where ‘bugs’ in the intervention are resolved quickly and without the expense and complexity of high fidelity simulation or risk of failure in practice. It will also allow us to train staff off-line and to gradually expose more to the interventions as they become more mature, leaving the final operational trials largely for ensuring integration with other parts of the system

Part Task Simulation		**Full Simulation**		**Operational Trials**
Low fidelity Limited, controlled tasks Individuals/ small teams Semi-experimental trials	→	High fidelity Complete unconstrained tasks Full teams Evaluative trials	→	Broader systems analysis Real tasks All required personnel Integrative trials

The Smartphone application will be the first simulation study conducted as part of the handoff improvement work. Initial tests will focus on part-task user evaluations of the interface, based around different user profiles (attending, resident, ED nurses, MICNs), and their different interactions with the technology. This will help identify bugs or inconsistencies in the user interface. The interaction will be deliberately slowed down to enable thoughtful and thorough examination. The process is driven by a scenario, which guides the exploration of the user interface step-by step. At each step, the user participants are asked to describe what they would do next, such as open a drop-down, click on a link to a particular page, or the like. In this way, every interaction context that is visited gets a thorough review.

We will then move to a full simulation session, taking into account our learning from phase I regarding the value of realistic contextual referents (and sometimes distracters) that help the participants to engage fully in the simulation activity, and assist in the uncovering of realistic findings.

During the scenarios, we will identify usability defects, which is described as “*Any feature, function, or facet of the user interface or its organization that violates established principles of usability (e.g., visibility, feedback, etc.) or that is likely to lead to user error, delay, confusion, or the failure to complete a task.*” The following questions will be used as a guide to help identify usability defects while watching the end users engage with the smartphone application:.

a) What: the particular feature, function, or facility that is the problem.
b) Where: the exact location of the defect within the user interface.
c) How: description or nature of the defect.
d) Why: the particular rationale or principle that makes it a defect.
e) How bad: the estimated severity of the problem in the context of how much it impairs a particular task and the application as a whole.

This will allow the first iteration of the application to be further developed before being trialled in full simulation. Both part-task and full simulation scenarios have been developed, and we are currently awaiting completion of the first trial version of the application.

Aim 2, Task D: successful interventions tested and refined at CSMC and partners

We have not commenced work on this task.

Aim 2, Task E: findings disseminated as best practices

We have not commenced work on this task.

Key Research Accomplishments

The key research accomplishments so far have been in:

- Expanding the definition of handoffs and care transitions for the unique demands of trauma care
- Mapping the transitions and handoffs along the trauma pathway
- Conducting pilot observations of shift handoff teamwork and process issues in the ICU
- Analyzing observational data on flow disruptions during care transitions reveals that
    - Most patients experience some disruption during care transition
    - Co-ordination problems are dominant causes
    - Fewer transitions may be better
- Analyzing hospital incident reports of handoffs, which reveals that task and teamwork causes are dominant
- Examined and structured methods to measure specific types of handoffs and transitions
- Developed two potential interventions based on previous work
- Planned initial simulation tests for one intervention.

Reportable Outcomes

The following abstracts have been accepted:

K. R. Catchpole, R. Blocker, E. Ley, A. Gangi, J. Blaha, B. Gewertz, D. Wiegmann. Flow Disruptions in Trauma Care Handoffs. Accepted for an oral presentation at the 8th Annual Academic Surgical Congress to be held February 5-7, 2013 in New Orleans, LA.

K. R. Catchpole, R. Blocker, Improving Hand-Offs Through Motor Racing Analogies and Human Factors Research, Accepted for an oral presentation at the Association for Perioperative Registered Nurses (AORN) Annual Conference in San Diego, USA Mar 3-7, 2013.

K.R. Catchpole. Task, Team and Technology Integration in Surgical Care. Invited oral presentation at the 2013 Symposium on Human Factors and Ergonomics in Health Care, March 11-13, 2013, Baltimore, Maryland, USA

K.R. Catchpole. Task, Team and Technology Integration in Surgical Care. Invited oral presentation at the 2013 Institute for Ergonomics and Human Factors Annual Conference, Cambridge, UK, 15-18 Apr, 2013.

A. Gangi, K. Catchpole, R. Blocker, D. Wiegmann, B. Gewertz, J. Blaha, E.J. Ley. Time To Prepare Impacts Emergency Department Efficiency And Flow Disruptions. Accepted for a Quick Shot Presentation at the 8th Annual Academic Surgical Congress to be held February 5-7, 2013 in New Orleans, LA.

Conclusion

Phase II of the Operating Room of the Future programme is progressing well. We have taken a broad approach to problem definition and early analysis. Already we have sufficient data to move toward academic publication of early results, and have two interventions – Smartphone technology and a Checklist – in development. In the next four months we will finalize and deploy task, process and teamwork observation metrics for the variety of handoffs and transitions that occur during trauma care, continue to analyze existing data, and conduct evaluative part-task simulations of our earlyinterventions.

Appendices

FLOW DISRUPTIONS IN TRAUMA CARE HANDOFFS

K. R. Catchpole, R. Blocker, E. Ley, A. Gangi, J. Blaha, B. Gewertz, D. Wiegmann. Flow Disruptions in Trauma Care Handoffs. Accepted for an oral presentation at the 8th Annual Academic Surgical Congress to be held February 5-7, 2013 in New Orleans, LA.

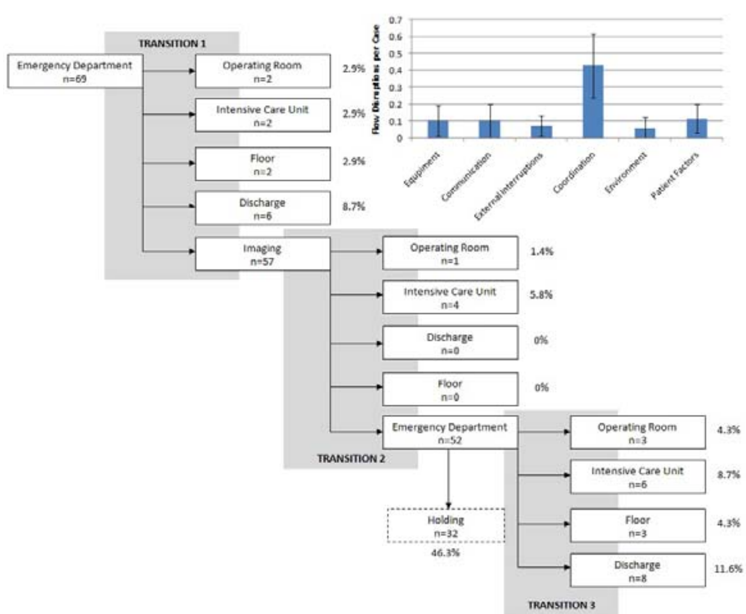
BACKGROUND: Effective handoffs of care are frequently cited as critical for maintaining safety and avoiding communication problems. Using the flow disruption observation technique, we sought to examine potential problems in transitions of care along the trauma pathway.

HYPOTHESIS: An increase in hand-offs in trauma care is associated with an increase in flow disruptions and a decrease in efficiency.

METHOD:A single observer, trained in the flow disruption direct observation technique, followed the patient from their arrival in the ED to the completion of their care. Patient flow was mapped to ascertain the different paths of care. Next, flow disruptions during the transition period were recorded and classified into one of seven categories (Equipment, Communication , External Interruptions, Coordination, Environment, Patient Factors, Technical Skills, Training, Other).

RESULTS: A total of 69 patients were studied (13high level and 56 low level traumas), and a total of 146 care transitions were observed, with flow disruptions occurring in 41% of care transitions. Of those transition flow disruptions, 30 (49%) were related to co-ordination problems. Mapping the transitions of care shows that approximately 83% of patients were assessed and transferred to imaging for further diagnostics, with 46% of patients arriving back in the ED following imaging assessment to await further consultation or discharge assessment. 7% of patients return to the ED and then are transferred to the ICU or OR. 61 flow disruptions were found during those care transitions, suggesting that on average 87% of patients experience a transition flow disruption during their care. Those patients who experienced more transitions experienced more transition flow disruptions and a longer case duration.

CONCLUSION: Transitions in trauma care, like other forms of handoffs, are vulnerable to systems problems and human errors. Reducing the number of transitions and improving co-ordination in transitions along the trauma pathway may reduce risks and improve efficiency.



Improving Hand-Offs Through Motor Racing Analogies and Human Factors Research

K. R. Catchpole, R. Blocker, Improving Hand-Offs Through Motor Racing Analogies and Human Factors Research, Accepted for an oral presentation at the Association for Perioperative Registered Nurses (AORN) Annual Conference in San Diego, USA Mar 3-7, 2013.

Effective handoffs are critical for maintaining quality of care across different care teams. While many new processes have been adopted, handoffs are still a major cause of inefficiency, risk and patient harm. Human factors is the science and practice of understanding and improving performance in complex systems, and in this session we will discuss the findings from three human factors research projects in three different types of handoff. The first project was to improve the safety of high risk patients being transferred from surgery to intensive care. By learning from motor racing team pit-stops, we were able to translate multiple dimensions of good practice into a safer, more efficient and highly effective handoff. The second section will describe a critical, but often forgotten form of handoff during surgery. This project examined effective and ineffective handoffs related to changes of surgical personnel during the operation. We will illustrate the potential risks and effects on the course of the operation, and discuss mitigation strategies. Finally, we will examine a four phase project to improve handoffs from the day team to the night team. We conducted multi-dimensional observational measures and studied making handoff changes within the complex hospital system.

Objectives and Topics:

- Develop the concepts that underlie human performance in complex systems and factors practice. Provide examples of humans as hazards and humans as heroes; everyday examples of good and bad design, illustrating the need to look at human performance within an organizational context.
- Explain how to improve handoffs from surgery to intensive care and PACU. Describe the features of post-operative handoffs; describe a handoff improvement project in high-risk that learned from motor racing pit stops.
- Discuss the risks of micro-handoffs in surgery and how to mitigate them. Illustrate with a research project examining changes in operating team personnel that identified effective and ineffective practice.
- Identify the risks and mitigative strategies for handoffs between night and day shifts. Description of a 4 phase research project to improve handoffs between day and night shifts, encompassing organizational and behavioral interventions.

Task, Team and Technology Integration in Surgical Care

K.R. Catchpole. Task, Team and Technology Integration in Surgical Care. Invited oral presentation at the 2013 Symposium on Human Factors and Ergonomics in Health Care, March 11-13, 2013, Baltimore, Maryland, USA

BRIEF SUMMARY: Arguably the two major deployments of human factors expertise in healthcare in the last decade has been the use of direct observation methodologies to understand the complexity, strengths, and weaknesses of healthcare system; and the focus on teamwork and communication as a cause and solution to healthcare safety and performance problems. By and large the understanding of safety and performance – and teamwork in particular - has been dominated by simplistic views derived from aviation or other high risk industries. Though once valuable to begin to understand the nature of errors in healthcare, it is time that this view should be challenged. Direct observation tells us that he relationship between team, task and process in different is complex. To examine the problems behind this assumption, we will focus on four different types of surgical care: cardiac, orthopedic, robotic and trauma surgery.

SIGNIFICANCE & TAKEAWAY: Direct observation of teamwork and process in surgical care is a vital and developing methodology that helps to understand work as performed rather than work as imagined. In cardiac surgery, the anesthesiologist, the surgeon and the perfusionist need to co-ordiate their actions and use of equipment to ensure that the patient is kept appropriately stable. In hip and knee replacement surgery, the key relationship is between the scrub nurse and the surgeon. Robotic technology changes the teamwork and task requirements, not only physically, but also in terms of the requirement to think ahead more. Trauma is defined through the requirements to orchestrating a complex set of processes with a wide variety of staff, and the associated varying technological tools in a variety of geographical locations, while working under substantial uncertainty and time pressure. Thus, there are key differences in the teamwork and technological requirements for different types of surgical care that go well beyond the simplistic models adopted from other high-risk industries. Further study should focus not only on what goes wrong – but especially on what goes right, and extend team interventions beyond extra tasks, single checklists, or training.

Task, Team and Technology Integration in Surgical Care

K.R. Catchpole. Task, Team and Technology Integration in Surgical Care. Invited oral presentation at the 2013 Institute for Ergonomics and Human Factors Annual Conference, Cambridge, UK, 15-18 Apr, 2013.

Teamwork training solutions based on Crew Resource Management have been popular in healthcare as a solution to patient safety problems. In this paper, I argue that team and technology requirements vary considerably with the types of surgery undertaken; and thus, that a more sophisticated model of process improvement in healthcare is required.

Introduction

Arguably the two major deployments of human factors expertise in healthcare in the last decade have been the use of direct observation methodologies to understand the complexity, strengths, and weaknesses of healthcare system; and the focus on teamwork and communication as a cause and solution to healthcare safety and performance problems. The methodological model has been perhaps the only way to understand work as performed at the sharp end (Catchpole & Wiegmann 2012), in order to distinguish between "work as imagined" vs "work as performed". Each new direct observation study has revealed new insights into the pressures, and every day problems associated with working in healthcare that illustrate the vast mismatch not only between human abilities and system requirements – but also between what "should" happen and what "really" happens. Indeed, by and large the understanding of safety and performance – and teamwork in particular - has been dominated by simplistic views derived from aviation or other high risk industries(Leonard et al. 2004). Though once valuable to begin to understand the nature of errors in healthcare, it is time that this view should be challenged. Direct observation tells us that he relationship between team, task and process in different is complex.

It is an oft-quoted statistic that 80% (or a similar proportion) of incidents are caused by communication, and the emphasis on aviation models of care has been explicit and extensive. A great many observation studies in the last decade have examined teamwork and process in surgical care; and there have been multiple attempts to demonstrate the value of Crew Resource Management training in a variety of healthcare settings (Awad et al. 2005; Grogan et al. 2004; Young-Xu et al. 2011; McCulloch et al. 2011). There have also been a range of useful studies that have defined the non-technical skills of a variety of healthcare practitioners(Fletcher et al. 2003; Yule et al. 2006). This work has begun to establish a human factors presence in healthcare that hitherto had been omitted from the consideration of most healthcare systems. By and large, however, it has been assumed that teamwork exists independently of the task or the technology being used. To examine the problems behind this assumption, we will focus on four different types of surgical care.

Task, Technology and Teamwork in Cardiac Surgery

Cardiac surgery is the classic "high technology, high risk" surgery. In a seminal human factors study in surgery, direct observation of teamwork and process demonstrated that small process problems could accumulate to affect outcome if the surgical teams did not appropriately compensate for those problems (de Leval et al. 2000). Further studies using video recordings were able to examine exactly how these life-threatening events arose (Catchpole et al. 2006). Analyses of these events demonstrate the close coupling between task, team and technology for the management of safe, effective cardiac surgery. The management of perfusion (sufficient oxygen supply to the brain and vital organs) while the heart is being operated is the key component of the success of an operation. The anesthetist, the surgeon and the perfusionist need to co-ordiate their actions and use of equipment to ensure that the patient is kept appropriately stable and the surgical field free of blood to allow the operation to move forward. This can be a delicate balance, and malfunctioning technology, mis-communications or unclear task definition can upset the process at any one time. Examples have been previously published of where and how problems with any one of these components can upset the rhythm of the operation, and can lead to vastly increased risks (Catchpole, 2011). As a consequence, in these types of operations, the most frequent disruptions to optimal care are communication/co-ordination issues, staff absences, and equipment problems

Task, Technology and Teamwork in Orthopedic Surgery

Several studies have been conducted in orthopedics. In hip and knee replacement surgery, the key relationship is between the scrub nurse and the surgeon. The anesthesiologist is rarely involved directly in the team as their task – to keep the patient stable – is largely unaffected by the course of the operation. Orthopedic surgical kits utilize 6 to 18 or more trays of jigs, cutting blocks, screws, rods, inserts and other highly technical metalwork in order to measure and configure the replacement joint. In order to keep the process running, the scrub nurse needs to have a well developed understanding of when, and especially how, all the kit will be used. Each manufacturer’s method, technology and configuration requirements are different, which means that process and sometimes teamwork will break down if either the surgeon or the scrub nurse are using equipment they are unfamiliar with. Given that space in an operating room can be limited, management of the different trays, which need to be stacked on top of each other, requires considerable physical effort, a detailed knowledge of where every piece can be found in every tray, and good anticipation of and communication about the next phase in the surgical process. As a further observation, this equipment has generally not been optimized from a usability stand point, and allows incorrect configurations, which clearly raises further safety issues. In these operations, the most frequent problems are related to distractions and equipment or workspace management (Catchpole et al. 2007).

Task, Technology and Teamwork in Robotic Surgery

We have also been conducting new studies examining robotic surgery. This growing field of surgical endeavor has distinct advantages in offering keyhole (laparoscopic) surgery with a greater range of articulation than would be offered in more traditional laparoscopy, while removing hand tremor effects. Several ports are placed into the abdomen of the patient, which are then docked to the robot. The surgeon then sits at a terminal, several feet away from the operating table, placing his head and hands into an enclosure that allows him to see via 3D camera, and manipulate his devices remotely in several articulatory dimensions. This new technology changes the teamwork and task requirements in several ways. First, being remote from the scrub tech and assistant surgeon who remain at the operating table means that they are no longer directly working alongside the rest of their team. There may be a microphone/speaker system to substitute for direct communication, but this does not wholly substitute. For example, a frequent observation is where the arms of the robot interfere and are interfered with accidentally by the assistant surgeon, who can experience discomfort and minor crushing as the arms can pin him in unsually contorted locations. Furthermore, the need to change instruments – which is a process that can take several minutes, rather than the few seconds in more traditional surgery, means that the ability to think ahead and communicate anticipated requirements amongst the team are particularly important. Our recent findings suggest that more experienced surgeons have considerably smoother operations, in part because they are able to minimize the number of times instruments are changed.

Task, Technology and Teamwork in Trauma Care

Finally, direct observational work in the trauma setting reveals yet another interaction between technology, team and process. We followed patients from when they arrive into the ED to their eventual arrival on a ward, ICU, post-operative care, or discharge. Trauma is defined through the requirements to orchestrating a complex set of processes, involving ED nurses, ED doctors, trauma doctors, Ambulance/Fire crews, Radiography and OR staff, and the associated varying technological tools in a variety of geographical locations, while working under substantial uncertainty and time pressure. Consequently, we found most frequent problems relate not to communication, but to co-ordination of all those components. There is a major information management component to this work, which we have been exploring through the use of technology, as well as developing and delivering trauma-specific teamwork training.

Conclusions

Direct observation of teamwork and process in surgical care is a vital and developing methodology that helps to understand work as performed rather than work as imagined. This has revealed key differences in the teamwork and technological requirements for different types of surgical care, that go well beyond the simplistic models adopted from other high-risk industries. Further study should focus not only on what goes wrong – but especially on what goes right, and extend team interventions beyond extra tasks, single checklists, or training.

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Time to Prepare Impacts Emergency Department Efficiency and Flow Disruptions

Gangi, K. Catchpole, R. Blocker, D. Wiegmann, B. Gewertz, J. Blaha, E.J. Ley. Time To Prepare Impacts Emergency Department Efficiency And Flow Disruptions. Accepted for a Quick Shot Presentation at the 8th Annual Academic Surgical Congress to be held February 5-7, 2013 in New Orleans, LA.

Introduction: Effective trauma care requires coordinated performance at multiple stages including "on scene" care and transport (pre-hospital phase) and care in the emergency department (hospital phase). We sought to determine if the interval between the notification of incoming trauma and the time of the patients' arrival in the emergency department ("activation to arrival time") affects the efficiency of care. We postulate that less time to prepare for patient arrival results in increases in time in the emergency department and an increased number of deviations from the natural progression of care ("flow disruptions", FD).

Patients and Methods: A prospective, observational study at a level I trauma center was conducted to identify and quantify flow disruptions at different phases of care from activation to termination of a case. Seven trained observers recorded flow disruptions in 87 consecutive trauma cases over two months using a validated Tablet-PC data collection tool and recorded work-system variables related to breakdowns in communication, coordination, environmental distractions, equipment issues and patient factors. Cases were then stratified into two groups based upon time from activation to patient arrival: 0-8 min (31 cases) and > 9 min (33 cases).

Results: A total of 87 cases were observed of which 64 met study criteria. Neither time in the emergency department (66.01 v. 61.11 min) nor overall case duration (102.78 v. 98.19 min) was affected by the time to prepare. However, a longer time to prepare (>9 min) increased the number of emergency department FD (7.74 v. 11.66, p=0.034) and ED FD per min (0.155 v. 0.247, p=0.022).

Conclusion: This study used human factor methodology to document the impact of trauma “activation to arrival” time on efficiency and FD. Our findings suggest that implementing standardized interventions that can provide system-level support for coordination and preparation of patient care may result in fewer flow disruptions and safer and more efficient trauma care.